THE TAXONOMIC STATUS OF AEDES MATHESONI
(DIPTERA, CULICIDAE)

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The present work deals with a comparative study of the scale patterns of the adults and larval chaetotaxy of *Aedes mathesoni* Middlekauff and *Aedes canadensis* (Theobald). Rings and Hill (1946) have indicated that *A. mathesoni* bears a close phylogenetic relationship to *A. canadensis*. Morphological examinations of the larval stages of both species have shown that the primary distinguishing characteristics intergrade to such an extent that positive identification of *mathesoni* is impossible. The data here presented are interpreted by the authors as evidence that *mathesoni* is a melanistic, geographical variation of *A. canadensis*.

Comparison of Adult Females

The most striking difference between the females of the two forms is the greater prevalence of black scales and the more intense purplish-black coloration in *mathesoni* as compared with *canadensis*. The latter has varying shades of brownish scales, those on the mesonotum usually golden-brown, and a proportionately greater amount of white scaling. The mesonotum of *mathesoni* appears blackish-brown with certain characteristic areas of silvery or yellowish-white scales as illustrated in Figure 1, A. This figure has been drawn from Middlekauff's description and perhaps does not represent an exact replication of a typical *mathesoni* pattern. A paratype female from MacDill Field, Tampa, Florida, was kindly loaned to the authors by Dr. Alan Stone but the specimen had been trap-collected and the mesonotal pattern was indistinct. Figure 1, B represents a typical mesonotal pattern of intergrades from Camp Blanding, Florida, and it is quite possible that this figure more closely resembles a true *mathesoni* pattern than does A. In these intergrades there is

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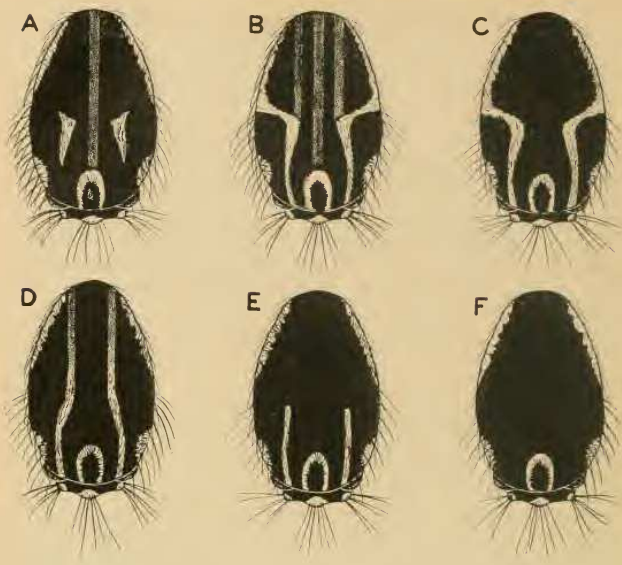

Figure 1. Mesonotal patterns of subspecies of *Aedes canadensis:* A, *Aedes canadensis mathesoni;* B, Intergrade; C, D, E and F, variations in pattern of *Aedes canadensis canadensis.*

a narrow, longitudinal, median line of curved, very small, dark golden-brown scales extending nearly to the antescutellar space. The median line is bordered on either side by a similar line which extends only half the length of the mesonotum. There are elongate patches of silvery or yellowish-white scales bordering the anterior mesonotum when viewed dorsally. In reared specimens these elongate patches are continuous with curved lines of silvery white scales which extend to the posterior borders as illustrated. There are in addition patches of silvery scales in the supraalar region and surrounding the antescutellar space. Figure 1, C represents a specimen pattern of what is probably an intergrade although it was originally determined as *canadensis.* This mosquito was collected in Atlanta, Georgia. An interesting variation is presented in Figure 1, D where nearly parallel longitudinal lines of scales extend the length of the mesonotum. Figure 1, E represents a fairly common pattern of *canadensis* and has been observed

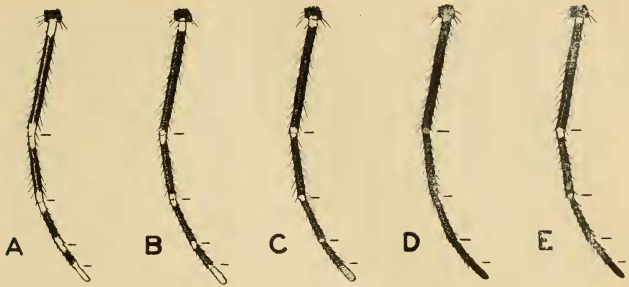

Figure 2. Hind tarsal patterns of subspecies of *Aedes canadensis:* A, *Aedes canadensis canadensis;* B, C, D, intergrades; E, *Aedes canadensis mathesoni.*

in specimens from Round Hill, Connecticut; Drew County, Arkansas; Eitzon, Minnesota; New Brunswick and Wayne, New Jersey. The most common mesonotal pattern of *canadensis* is depicted in Figure 1, F and it may be well to point out that the mesonotal vestiture of specimens C, D, E and F is much lighter than illustrated and is actually shades of golden brown. The intergrades from Florida and Georgia exhibited patterns which varied nearly as much as the six patterns in Figure 1.

The difference in tarsal patterns of the two forms is quite apparent and provides a simple method of separation provided that intergrades are not encountered. The hind tarsal patterns of *mathesoni, canadensis* and intergrades are illustrated in Figure 2. The intergrades represent selected individuals originally believed to be *mathesoni.* They were obtained as larval collections from Camp Blanding, Florida, and were reared to maturity in the laboratory at Fort McPherson, Georgia. A series of intergrades was also provided by Lt. Robert M. Russell, Sanitary Corps, who collected and reared the specimens at Camp Gordon, Augusta, Georgia. The tarsal pattern in this series of 15 male and 10 female specimens was typically that of *canadensis* except two females which had very narrow, white tarsal rings. In general, however, the dark scales of the tarsi were blacker in all specimens than in normal *canadensis.* The mesonotal coloration and pattern in these individuals most closely resembled *mathesoni.* It should be pointed out that the proportion of black and white scales on the hind tarsi is not consistent. The extent of white scales on the fifth tarsal segment apparently depends upon which surface is examined, some individuals having all dark scales

on one side and all pale scales on the opposite. The tarsal patterns in Figure 2 are drawn from an anterior view.

It is interesting to note that Coquillett (1904) described as new, *Culex nivitarsis*, a male and female specimen which were undoubtedly aberrant forms of *Aedes canadensis*. The tarsal pattern of these individuals was unique in that the corresponding opposite tarsal segments were dissimilar. In the female, the first segment of the right mid-tarsus, the fourth and fifth segments of the left mid-tarsus and the first and fifth segments of the hind tarsi were entirely white. The remaining segments were either black or white with black median rings. In regards to this Howard, Dyar and Knab (1917) state that, "Dr. C. S. Ludlow suggested to us that these specimens were only aberrations of *A. canadensis*, and we have adopted this view. We have examined the types (one male and one female in the collection of Dr. John B. Smith) and find the markings of the legs dissimilar on the two sides. The larvae of the two forms are indistinguishable."

An examination of a series of *canadensis* from Connecticut, New York, New Jersey, Minnesota, Nebraska, Arkansas and Georgia revealed that no apparent variation occurred in the tarsal pattern. The intergradation of the normal *canadensis* pattern into the intermediate patterns in northern Florida is most illustrative of geographical variation.

Several other minor differences in color pattern of the two subspecies are evident upon closer examination. These differences are similar to those cited for the mesonotal and tarsal patterns and are apparently based upon the distribution and concentration of melanin in the scales. The abdominal tergites of *mathesoni* are covered with purplish-black scales without markings dorsally while in *canadensis* the scales are blackish, sometimes with a greenish reflection, but with narrow bands of pale scales on each segment. These bands widen laterally and are interrupted medianly on the sixth and seventh abdominal segments. A lateral view of the abdomen of *mathesoni* reveals small, triangular, basal, segmental areas of white scales which extend over the basal third of the segments ventrally. It is apparent that the narrow dorsal bands in *canadensis* have been obscured by darker pigmentation in *mathesoni*. The palpi also show differences in the distribution of melanin while the scales of the proboscis and wings differ in pigment concentration.

The series of intergrades from Camp Blanding, Florida as mentioned previously were reared to maturity in the laboratory at Fort McPherson, Georgia. A series of *A. canadensis* larvae were collected at Jonesboro, Georgia and reared to the adult stage at the same time as the above series from northern

Florida. The rearing room of the laboratory was equipped with temperature and humidity control apparatus and was operated at 80° F. and 80 per cent relative humidity. Although both series were reared to maturity under identical environmental conditions the adults emerging from the two collections were markedly different. These results would indicate that either the melanistic tendency was due to heredity or was a manifestation of the indirect effects of temperature upon certain physiological processes in early larval development. Johnson (1910) has shown that color variations, even minor ones, were inherited in lady beetles.

There are numerous publications which point out the fact that melanism is correlated with climatic factors. Temperature is probably the most important of these in producing melanistic races or individuals although in some instances humidity has also been shown to play an important role. Color variation in insects, generally, is in agreement with Glogler's rule. This biological law states that the melanistic individuals increase in the warm and humid parts of the range of the species. One investigator, Knight (1924), however, found that the reverse was true in the predaceous *Perillus bioculatus* (Hemiptera), if the species was reared under different temperatures in a given locality.

A comparison of the observations in the present study and those made by Michener (1945) in studying seasonal variation in *Culex apicalis* is extremely interesting. This worker found that the darker summer form was present in certain areas in Florida throughout the year and present in other areas northward to Maryland only during the summer period. The winter form, characterized by more prominent, whitish, abdominal bands apparently retained its color pattern throughout its northern range. Winter and summer forms occurred seasonally in North Carolina, South Carolina, Tennessee, Georgia, Mississippi and Alabama. An apparent subspecies, *Culex derivator*, is mentioned which lacks the pale scaling on the abdominal terga altogether, or, at most has small white areas latero-apically.

Comparison of Adult Males

The differences in color patterns of the male specimens of *mathesoni* and *canadensis* are essentially the same as those mentioned for female individuals. It is interesting to note that in the allotype *mathesoni* male the hind tarsi are all dark-scaled with the exception of a narrow band of whitish scales at the base and apex of the basitarsus and the base of the second tarsal segment. This specimen was collected at Camp Murphy, Florida which is considerably south of the type locality.

In the original description of *mathesoni* (1944) Middlekauff states that "The male genitalia of *canadensis* differ only slightly, the spines of the ninth tergite being less regularly placed and more abundant, and the tenth sternite being somewhat curved and acute apically." The genitalia of the northern Florida intergrades differed slightly from the description of the *mathesoni* male. The tenth sternite more closely resembled that of *canadensis* than *mathesoni* and the spines of the ninth tergite were more irregularly placed.

Comparison of Larvae

It has previously been mentioned by Rings and Hill (1946) that the only apparent difference between the larvae of the two subspecies is the degree of branching in the head hair and antennal hair tufts. The number of branches in head hair tufts increase as the warmer regions of natural distribution are approached. The head hair tufts have been used as a measure of this peculiar characteristic since they are most often used in determination procedures. When the annual mean temperatures of the larval collection localities are composed with the mean number of upper and lower head hair branches of the larvae of both subspecies a close correlation is apparent. These data are presented in Table 1.

Table 1. Correlation between number of branches in upper and lower head hair tufts with the annual mean temperature of the collection locality.

Annual mean temperature in locality of col. (°F)	Mean number of upper head hair branches	Mean number of lower head hair branches	Number of specimens examined
30-40	5.2	4.0	3
40-50	5.3	3.6	15
50-60	6.5	4.8	25
60-70	7.9	5.5	79
70-80	10.7	7.2	11
Totals			133

The annual mean temperatures have been grouped in units of 10 due to the fact that only a small series of larvae were available for study from widely separated localities. A larger series of specimens from fewer, well selected localities should show a much better correlation.

Other instances of temperature effects upon structure have been reported by several zoologists. Hegner (1919) states that the spines of certain Protozoa are longer when developed at higher temperatures than at lower temperatures. Also, Roberts (1918) reports in *Drosophila* that an increase of a few

degrees temperature gave longer wings in mutant forms than did 29 generations of selective mating.

Distribution of the Subspecies

The general distribution of the subspecies of *Aedes canadensis* is presented in Figure 3. Locality records indicate that the range of the subspecies overlaps from approximately the middle of Florida northward into eastern Georgia and South Carolina. The species is apparently confined to the humid climatic areas of North America extending from the lower Canadian coniferous forests to the semi-tropical areas of Florida. *Aedes canadensis* occurs in apparently isolated areas on both the lower forested slopes of the Rocky Mountains. It is known to occur in British Columbia and probably extends southward into California, however, no record of the species occurring in Washington, Oregon or California is known to the authors. Most of the Floridian records of *canadensis* were obtained through the courtesy of the U. S. Public Health Service, Jacksonville, Florida and include data from Army installations. These records show that a single male specimen of *canadensis* was collected at West Palm Beach, Florida and was determined by an examination of the genitalia. However, since the genitalia of the two subspecies are so similar this record is not included as *canadensis*. *Aedes canadensis mathesoni* has been collected as far south as West Palm Beach, Florida.

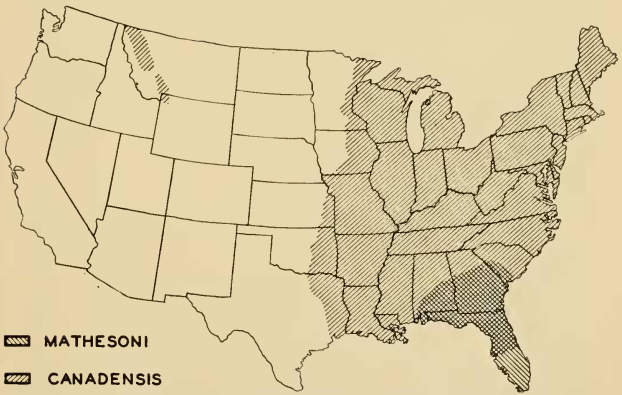

Figure 3. Distribution of the subspecies of *Aedes canadensis* in the United States.

Conclusions

The phylogenetic rank of subspecies is generally applied to a part of a species showing geographical variations which intergrade with a subspecies occupying different though usually adjacent and overlapping parts of the general range of the species. Geographical variation is generally considered to be due to the influence of climatic factors, either directly or indirectly. *Aedes canadensis mathesoni,* when considered as a subspecies or geographical variation of *Aedes canadensis* exhibits charactistics that would be expected when the higher temperatures are encountered in the warmer parts of its natural range. Intergradation in color pattern of the adults and structures of the larvae of the two forms have previously been shown. Temperature is considered to be the most important climatic factor since observation has shown that other factors do not influence pigmentation in this species. The present study indicates that differences in color are especially obvious in this species with respect to latitudinal distribution. These color variations may be reduced to two phases of modification, (a) a general increase in intensity at the southward; and (b) an increase in the extent of dark or black markings at the expense of the intervening lighter or white ones, or conversely, the reduction in size of white areas. Under the general increase in intensity, the iridescence becomes greater and the browns appear much darker and assume a blackish hue. An exception to this principle is evident in the mesonotal pattern wherein the isolated lines of pale scales seem to increase in number and extent in the warmer regions.

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ENTOMOLOGICAL SOCIETY OF WASHINGTON, 576TH REGULAR MEETING, NOVEMBER 6, 1947

The 576th regular meeting of the Society was held at 8 P.M., Thursday, Nov. 6, 1947 in Room 43 of the United States National Museum. President Clark presided and 45 members and 15 visitors were present. The minutes of the previous meeting were approved as read.

The following persons were elected to membership:

Cyril F. dos Passos, Washington Corners, Mendham, N. J.

John G. Franclemont, Division of Insect Identification, U. S. Bureau of Entomology and Plant Quarantine

George B. Vogt, Assistant Professor of Entomology, University of Maryland

President Clark appointed committees as follows:

Nominating Committee: R. E. Snodgrass, Chairman, Paul W. Oman, E. R. Sasscer.

Committee to Report on the Condition of the Reserve Stock of Publications: William D. Field, Chairman, Alan Stone. This Committee was appointed at the request of the Corresponding Secretary, Dr. Sailer.

A letter from Irston R. Barnes, President of the Audubon Society of the District of Columbia, was read by President Clark. This letter notified our members of two seminars to be held this winter by the Audubon Society, one on *Birds, Wildlife and Man*, the other on the *Geography of Birds*.

Dr. Sailer exhibited year-old specimens of sweet potatoes infested with lepidopterous larvae. He called special attention to the presence of termites also living in the potatoes.

Dr. Shepard displayed a new book by V. G. Dethier entitled Chemical Insect Attractants and Repellents. It contains 289 pages and was published by Blakiston. Seven of the ten chapters refer specifically to attractants, one to repellents, and two are devoted to more general discussion.

Dr. W. R. Kirner, Director of the National Research Council Chemical-Biological Coordination Center briefly described the work of the various